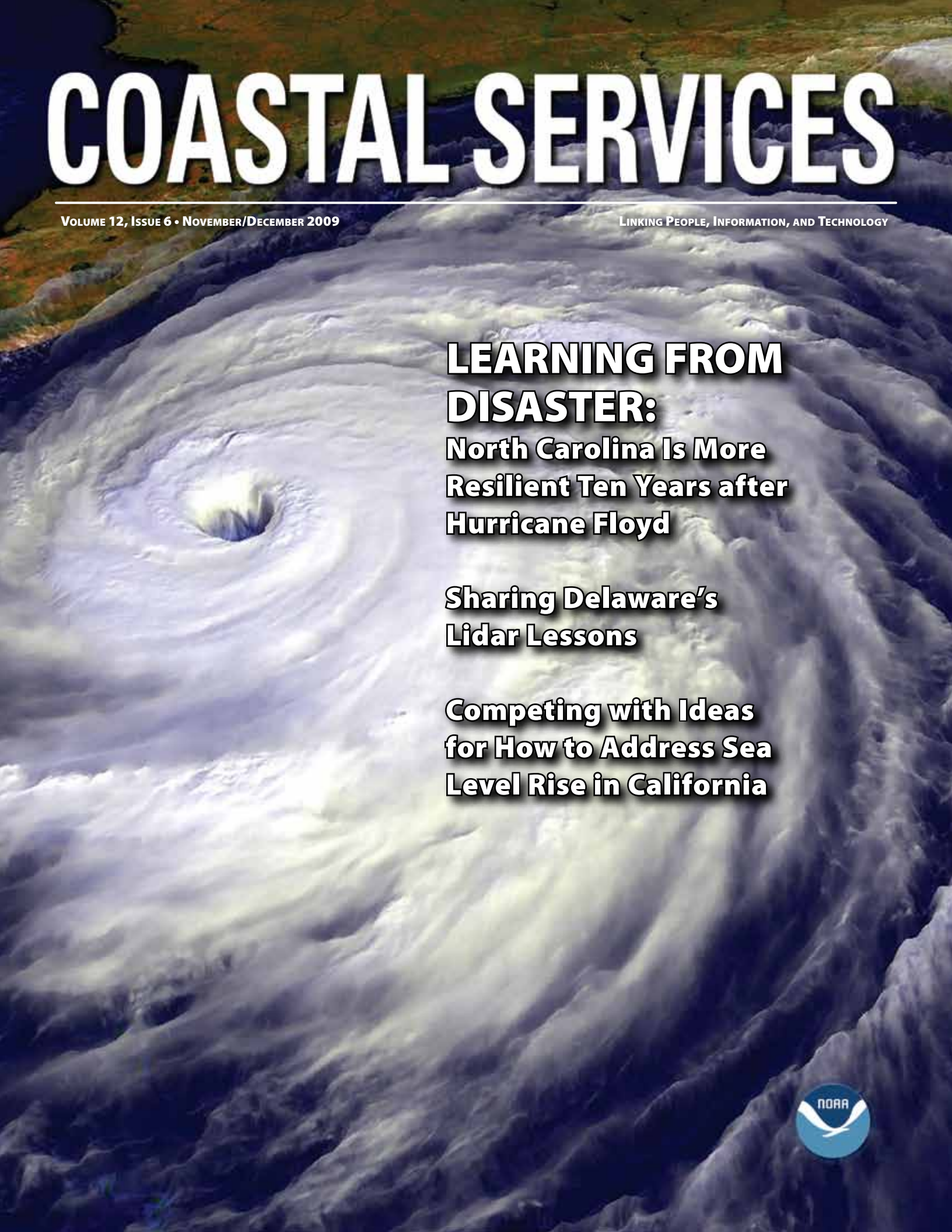
COASTAL SERVICES

Volume 12, Issue 6 • November/December 2009

Linking People, Information, and Technology



LEARNING FROM DISASTER:

North Carolina Is More Resilient Ten Years after Hurricane Floyd

Sharing Delaware's Lidar Lessons

Competing with Ideas for How to Address Sea Level Rise in California

From the Director

Ten years ago, Hurricane Floyd pounded the Bahamas as a category 4 storm and resulted in one of the largest peacetime evacuations in the U.S. as it threatened the coasts of Florida and South Carolina. It finally came ashore in North Carolina on September 16, 1999, as a category 2 storm, where it sat, dumping 15 to 20 inches of rain in some portions of the state that had been saturated by Hurricane Dennis just two weeks before.

Floyd's wind, waves, and torrential rainfall severely impacted almost the entire state of North Carolina, making it one of the worst disasters in that state's history.

Out of that storm have come many successful programs and projects that have resulted in the state being better prepared for disaster—and able to rebound more quickly should it strike again.

The cover story of this edition of *Coastal Services* examines some of the Floyd success stories and shares the primary lesson that North Carolina coastal resource managers learned—be as prepared as possible before disaster strikes.

While North Carolina has spent considerable funds to be prepared, cost-benefit analysis shows that the state is actually saving money in the long term.

A take-away message: spending a little extra money today to plan for and address the potential impacts from natural disasters or climate change could save significant amounts of money later.

To help coastal communities with this process, a new Digital Coast resource focusing on coastal inundation issues has recently been released by the National Oceanic and Atmospheric Administration Coastal Services Center and numerous partners.

In addition to data and tools, the Coastal Inundation Toolkit provides basic information on coastal inundation, risk communication, and how other communities are developing and using risk assessments, including a more detailed list of Delaware's lidar lessons, which is a feature story in this *Coastal Services* edition.

Go to the Coastal Inundation Toolkit at *www.csc.noaa.gov/inundation/*, and be sure to share your coastal inundation planning success stories with us. ❖

Margaret A. Davidson

The mission of the NOAA Coastal Services Center is to support the environmental, social, and economic well being of the coast by linking people, information, and technology.

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News and Notes

Smart Growth for Coastal and Waterfront Communities

Coastal and waterfront communities have a distinctive sense of place. The water, beaches, cliffs, rocky shores, and other natural features attract people and spur development.

Smart growth approaches to development are guided by a set of principles that help communities grow in ways that expand economic opportunity, protect public health and the environment, and enhance places that people care about. Some of these approaches also help communities become more resilient to the hazards created by weather and climate, including drought, sea level rise, and coastal inland flooding.

A new publication shows how to best apply the basic smart growth principles in a coastal setting. *Smart Growth for Coastal and Waterfront Communities* was developed by the National Oceanic and Atmospheric Administration (NOAA), along with the U.S. Environmental Protection Agency, the International City/County Management Association, and Rhode Island Sea Grant.

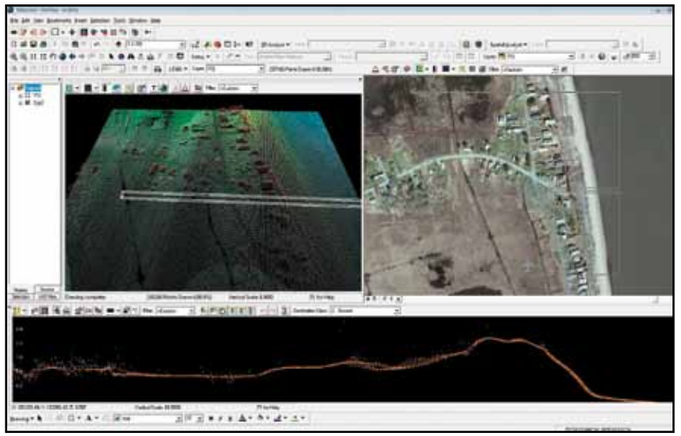
"The guidebook is arranged around the coastal version of the basic ten principles of smart growth development," says Susan Fox, one of the project contributors from the NOAA Coastal Services Center. "Each principle includes information about growth-related challenges and opportunities, a description of tools and techniques for applying smart growth, and case studies that illustrate implementation."

Smart Growth Coastal and Waterfront Elements

1. Mix land uses, including water-dependent uses.
2. Take advantage of compact community design that enhances, preserves, and provides access to waterfront resources.
3. Provide a range of housing opportunities and choices to meet the needs of both seasonal and permanent residents.
4. Create walkable communities with physical and visual access to and along the waterfront for public use.
5. Foster distinctive, attractive communities with a strong sense of place that capitalizes on the waterfront's heritage.
6. Preserve open space, farmland, natural beauty, and the critical environmental areas that characterize and support coastal and waterfront communities.
7. Strengthen and direct development toward existing communities, and encourage waterfront revitalization.
8. Provide a variety of land- and water-based transportation options.
9. Make development decisions predictable, fair, and cost effective through consistent policies and coordinated permitting processes.
10. Encourage community and stakeholder collaboration in development decisions, ensuring that public interests in and rights of access to the waterfront and coastal waters are upheld. ❖

An electronic copy of Smart Growth for Coastal and Waterfront Communities is available from www.coastalsmartgrowth.noaa.gov. To receive a hard copy, e-mail Donna.Mccaskill@noaa.gov.

Sharing Delaware's Lidar Lessons



Lidar data of the local community of Kitts Hummock in Delaware.

More and more, emergency and coastal resource managers are using lidar technology to acquire elevation data for incorporation into state and local maps being used for flood and other natural hazards planning. Coastal managers in Delaware were trailblazers in collecting and using lidar data and have learned hard-won lessons they can pass on to other states.

"We muddled through the hard way and are still one of the few states to have statewide lidar," says David Carter, environmental program manager for the Delaware Coastal Programs in the state Department of Natural Resources and Environmental Control's Division of Soil and Water Conservation. "Our staff members are now intimately familiar with lidar, its uses, and what you need to do" to collect it.

Carter adds, "Lidar is very expensive to do . . . and in the fiscal climate now, states need to be able to hit the ground running as soon as the data is delivered."

Measuring Pulses

Lidar is an active sensor—similar to radar—that transmits laser pulses to a target and records the time it takes for each pulse to return to the sensor's receiver.

The lidar sensor is mounted to the bottom of an aircraft and integrated with Global Positioning System (GPS) and inertial measurement unit (IMU) technology. Measuring the pulse return rate determines the surface elevation and is used to create high-resolution topographic maps.

Delaware's statewide lidar coverage came from two separate collection projects, undertaken two years apart. At the time these data collection projects were proposed, very few of the state's employees had experience with lidar data, or had the ability to work with extremely large data sets.

> *"We muddled through the hard way and are still one of the few states to have statewide lidar."*
>
> *David Carter, Delaware Coastal Programs*

Big Picture Potential

Efforts began in 2002 to get the funding to collect lidar in Delaware in order to develop digital flood insurance rate maps. In addition, coastal managers hoped that the high detail elevation data could be used for habitat studies or vegetation identification.

In 2005, a coalition of the Department of Natural Resources and Environmental Control, U.S. Department of Agriculture, and the Delaware Geological Survey contracted with the U.S. Geological Survey and NASA to collect lidar for Sussex County using NASA's Experimental Advanced Airborne Research Lidar (EAARL), which is specifically designed to measure submerged topography and adjacent coastal land elevations.

Because Delaware did not have capacity to run the EAARL processing software, lidar-based habitat and vegetation studies were not realized.

"We did not have the capabilities in-house to know the big picture potential, so we deferred to the federal agencies," Carter says. "We were getting different guidelines and documents, which made it very difficult to sort out what we needed."

Storm Devastation

On September 15, 2003, the Glenville community in Delaware was flooded by Tropical Storm Henri. After the storm, 172 homes were bought out by using federal, state, and local government resources, and the community was abandoned in 2004.

"Legislators and others were asking how this could possibly happen," Carter says. "The answer was that we didn't have elevation data or a monitoring system that would warn us. The reaction was to spend the money to get this data statewide."

In 2007, the lidar for the remaining two counties in the state was collected by a commercial contractor as part of a statewide orthoimagery collection project.

Processing Problems

Because of processing problems, by the time the 2007 lidar was flown, Delaware managers still did not have usable data from the 2005 flight. As a result, lessons learned were not incorporated into the second contract.

Problems encountered included the incompatibility of the EAARL data and the 2007 lidar, and that a third-party quality assurance and quality control was not conducted, both of which delayed the availability of usable statewide lidar.

Voice of Experience

Having worked through all the problems, Delaware emergency managers and researchers have been able to use lidar to develop statewide inundation maps, are incorporating the data into flood and storm surge modeling, and are using it to create an early flood-warning system.

While they learned the hard way, it should be much easier for coastal managers to collect and use lidar today, Carter says. "There are tools and training available now to work with this data that didn't exist in 2002."

In addition, Carter is hoping that the lessons they have learned will be useful to other managers.

"I would recommend," he says, "spending a whole lot of time on the phone with states who have gone through this." ❖

For more information, you may contact David Carter at (302) 739-9283, or David.Carter@state.de.us, or Bob Scarborough at (302) 739-3436, ext.14, or Bob.Scarborough@state.de.us.

National Oceanic and Atmospheric Administration Coastal Services Center staff members Dave Easter and Keil Schmid contributed to this article.

Lessons Learned

Here are Delaware's top five lessons learned about obtaining lidar data. For a more detailed list, go to *www.csc.noaa.gov/digitalcoast/inundation/map/obtain.html*

Agree on data standards. Before committing to project-specific deliverables, it is important to consider the various end uses. The choices made in data processing or delivered products may limit other uses of the data.

Know the end users' technical capacity. The hardware and software capabilities of the end users should be assessed to determine appropriate tiling and file sizes.

A common format should be used for an entire state. In Delaware, counties were mapped using different and incompatible systems, causing problems in merging data sets for statewide coverage and in other statewide analyses.

Ensure all data and products are contract deliverables. When developing a contract, ask all the end users to review the contracts to ensure that all the desired data and products are listed as deliverables. This should include the specification of each data product in the chosen format and, if applicable, resolution.

Metadata and Quality Assurance and Quality Control. Complete and accurate metadata must also be specified with all the deliverables. An important but sometimes overlooked aspect is the quality assurance and quality control of all data sets by a separate contractor or by the end users before final acceptance.

Image courtesy of Delaware Coastal Programs

LEARNING FROM DISASTER:

North Carolina Is More Resilient Ten Years after Hurricane Floyd

"We have learned that it is an awfully ill wind indeed that blows no one good, and a dark, dark cloud, for true, that doesn't have some sort of a silver lining."

Langston Hughes

Ten years ago, Hurricane Floyd left a track of devastation across North Carolina, becoming one of the worst disasters in the state's history. Today, coastal resource managers can point to the storm's many silver linings—successful programs and projects that have left a positive legacy.

"We have come up with solutions," says Chris Crew, state hazard mitigation officer for the North Carolina Division of Emergency Management. "North Carolina is now more disaster resistant."

These solutions include improved disaster preparedness and response coordination by the state's coastal managers, the implementation of emergency permits for rebuilding coastal property, buyout programs that are reducing flood impacts, relief grants for fishermen, and improved floodplain mapping that is serving as a national model.

While rebuilding has taken place and managers are better prepared than ever for future storms, Jack Thigpen, extension director for North Carolina Sea Grant, notes that it is the emotional and personal scars left by the storm that have been harder to heal.

The Storm

Mid-September 1999, Floyd made landfall at Cape Fear, North Carolina, as a category 2 hurricane with sustained winds of 110 mph and a storm surge of about 10 feet. It also produced torrential rainfall in eastern North Carolina, adding more rain to an area hit by Hurricane Dennis just two weeks earlier.

The rains caused widespread flooding. Over a period of several weeks, nearly every river basin in the eastern part of the state exceeded 500-year flood levels. In total, Floyd was responsible for 57 fatalities and $6 billion in damage, mostly in North Carolina.

Wind, Waves, and Rain

As a result of Floyd's wind, waves, and torrential rain, thousands of families lost their homes, water quality suffered from chemical and sewage spills, and millions of farm animals perished. Muddy waters from rivers flowing to the coast resulted in dark sediment plumes in estuarine waters.

Over a period of several weeks, nearly every river basin in the eastern part of the state exceeded 500-year flood levels.

The fishing industry suffered extensive damage from the hurricane and floods. Fishing gear, vessels, and shoreside structures supporting both commercial and recreational fishing were damaged and lost. Many of the 7,900 licensed commercial fishermen could not fish for periods ranging from weeks to months.

The storm also caused shoreline erosion and wave damage along the entire North Carolina coast, affecting about 300 miles of shoreline.

Setting the Stage

North Carolina was better prepared than it might have been because Floyd was the last of a series of five storms that hit the state in the 1990s.

"Basically, in order to talk about what we learned in Floyd, we have to go back and set the stage by talking about our response to previous hurricanes," says David Moye, interim district manager for the Washington regional office in the North Carolina Department of Environment and Natural Resources' Division of Coastal Management.

Before the 1990s, North Carolina had not been hit by a major hurricane since Hurricane Hazel in 1954.

When Hurricanes Bertha and Fran arrived a month apart in 1996, "we didn't have a framework in place to allow for damage to be repaired on a wholesale level," Moye explains.

Hurricane Manual

The experiences with the storms before Floyd served as the basis for the creation of the state's hurricane manual, which came out in July 1999—just over a month before Floyd's arrival.

"What that did," Moye says, "was set policy for us for everything from preparedness prior to a storm, to long-range planning pre- and post-hurricane."

For instance, the manual includes cooperative agreements between the state and the Federal Emergency Management Agency (FEMA) to secure and access funding after a storm.

Emergency Permits

The manual also sets out state procedures for creating "storm permits" that allow property owners to repair or replace shorefront homes and structures, such as docks and revetments. These procedures were codified after Floyd, says Doug Huggett, major permits coordinator for the Division of Coastal Management.

"We did similar emergency permits for the other hurricanes, but we realized after Floyd that what we needed to do was formalize a general permit, which is easier to implement, instead of issuing an emergency proclamation after each storm," Huggett says.

Response Coordination

Another outcome of Floyd was the establishment of the North Carolina Department of Environment and Natural Resources' Disaster Response Center, which coordinates agency activities and communications, says Kenneth Taylor, chief of the North Carolina Geological Survey.

"We pass our information and analysis of potential and observed disaster impacts to the state Emergency Operations Center," Taylor says. There, emergency incident management technology is used to sort through reports coming in from many state agencies. That information is shared electronically with federal, state, and local governments.

Department resources, such as boats, planes, and personnel, are made available to respond to a disaster anywhere in the state.

The agency's Disaster Response Center also utilizes the department-wide geographic information system (GIS) capability to "assist in mapping the potential and observed disaster impacts," Taylor says. "We can generate a map and share it with everyone."

Mapping Program

One of the impacts of Floyd was that about 10,000 buildings and homes were destroyed, and about another 7,000 were severely damaged by massive flooding, says Chris Crew. Close to half of these structures were not in areas previously mapped as being in a 100-year—or even a 500-year—flood-hazard area.

"Even in 1999 we were still relying on maps that had been created in 1977 and '78," Crew recalls. "Between '77 and '99, a tremendous amount of growth went on all over North Carolina that resulted in a variety of impacts in Floyd. . .

Continued

That was the impetus for the state to come up with funds to update a whole new mapping system."

Since 2000, North Carolina's Floodplain Mapping Program has acquired ground elevation data using lidar and conducted engineering studies to update the flood maps for all 100 counties in the state, says John Dorman, the program's director. To accomplish this goal, $145 million—half from the state and half from FEMA—has been invested in the program.

Dorman notes that they have done a cost-benefit analysis of the mapping program showing that it has helped the state avoid $97 million a year in flooding costs. "For every dollar we have spent, we have $2.4 in benefit."

Buyout Program

After Floyd, the state used FEMA mitigation funding to purchase flood-prone properties and provide assistance for elevating other structures to both avoid future losses and help the thousands of families in immediate need.

"The hazard mitigation program was relatively new at that point," Crew says. "When Floyd came along, we were really just getting underway with mitigation activities associated with Hurricane Fran in 1996. After Floyd, we streamlined the acquisition process. . . By mid-November of '99 we were writing checks to local governments for the acquisition of property."

Fishermen Relief

Because of Floyd's severe impacts to the state's commercial fishermen, assistance was provided to help replace lost vessels and gear, says Don Hesselman, chief of the License and Statistics Section of the North Carolina Department of Environment and Natural Resources' Division of Marine Fisheries.

"We distributed $7 million in two phases of the relief program," Hesselman says. "This was the first time we had done this, so we had to come up with the rules and develop the methodology to distribute the aid."

Be Prepared

These are just a few of the many successful programs and projects that resulted from Hurricane Floyd. The biggest lesson learned from the storm, managers say, is to be as prepared as possible before disaster strikes.

"Global climate change is happening," says Kenneth Taylor. "That means storms are getting more unstable, and we need to be more prepared."

"You can never be 100 percent prepared up front to anticipate all circumstances," advises Doug Huggett, "but the more preparation you do up front, the better you are at adapting on the fly."

He adds, "Don't be lulled into a false sense of security. It may not be this year, or even this decade, but a storm will come to all of us at some point." ❖

For more information on the Division of Coastal Management's role, contact Doug Huggett at (252) 808-2808, or Doug.Huggett@ncdenr.gov, or David Moye at (252) 948-3852, or David.Moye@ncdenr.gov. For information on the state's Floodplain Mapping Program, contact John Dorman at (919) 715-5711, ext. 102, or John.Dorman@ncmail.net. For information on the buyout programs, contact Chris Crew, at (919) 715-8000, ext. 277, or jcrew@ncem.org. For information on assistance to fishermen, contact Don Hesselman at (252) 808-8099, or Don.Hesselman@ncdenr.gov. For information on Sea Grant's role, contact Jack Thigpen at (919) 515-3012, or jack_thigpen@ncsu.edu. For information on coordination and communication, contact Kenneth Taylor at (919) 733-2423, ext. 401, or Kenneth.B.Taylor@ncdenr.gov.

For More Information

- The autumn 2009 edition of North Carolina Sea Grant's *CoastWatch* focusing on Hurricane Floyd, *www.ncseagrant.org/home/coastwatch/*
- The North Carolina Floodplain Mapping Information System, *http://floodmaps.nc.gov*
- Information on managing risk, *www.ncihrm.com*

Competing with Ideas for How to Address Sea Level Rise in California

New and innovative ideas are needed to help communities adapt and respond to sea level rise resulting from climate change. To help generate these ideas, coastal resource managers in California held an international design competition for projects that address sea level rise in San Francisco Bay.

Three of the judges review the entries.

> ***"The six winning entries really begin to tell the story of adaptation to sea level rise."***
>
> ***Brad McCrea, San Francisco Bay Conservation and Development Commission***

"The goal was to move the discussion forward with regard to what the bay might look like in the future," says Brad McCrea, design analyst for the San Francisco Bay Conservation and Development Commission (BCDC), which sponsored the competition. "We thought a design competition would be a great way to generate new ideas for building along the shoreline."

The Rising Tides competition resulted in six first-place awards for ideas ranging from generating public awareness by using laser beams to create a temporary wall of light in San Francisco Bay where levees would be needed, to mechanically managing tides with a "ventilated" levee.

"There are ideas embedded in each of these that have potential for future planning," notes McCrea. "This really energized the design community and provided a way for them to join the discussion about sea level rise."

Eight Inches High and Rising

At the Golden Gate Bridge sits one of the oldest tide gauges in the U.S., which has shown that over the last 150 years San Francisco Bay has risen eight inches. The state is anticipating an additional rise of 16 inches by 2050.

"Forty years from now, the bay will be about a foot and a half higher," McCrea says. "Over 90 years from now, we expect San Francisco Bay to be about four and a half feet higher."

He adds, "We know the bay is going to rise, and we want to plan for a future when the bay is higher. . . Lots of people are working on policy and planning and education around this issue, but one of the voices that didn't have a forum was the design community."

On a Shoestring

With a $125,000 section 309 grant from the National Oceanic and Atmospheric Administration, BCDC hired a competition advisor, who helped the agency create signature graphics, devise the competition website, and spread the news around the world through the Internet.

Several companies and organizations stepped in to provide services at cost or for free.

"We did this on a shoestring," McCrea says. "It easily could have cost double what we spent. People came out of the woodwork and provided support services for next to nothing."

Responses from All Over

After the June 29 deadline, BCDC received 130 entries from 18 countries. Of the entries from the U.S., nearly half were from the East Coast and half were from the West Coast.

"We said you could design at any scale for any type of project, as long as it was relative to the San Francisco

Continued on Page 9

Photo courtesy of San Francisco Bay Conservation and Development Commission

Reaching Out with Social Media in Louisiana

As more and more users sign up for social media accounts, such as Facebook and Twitter, businesses and organizations are starting to see new marketing opportunities. Natural resource managers in Louisiana are discovering that taking advantage of social media is allowing them to have more direct communication with citizens—and more control over their messages.

> *"The best thing to do is put the story out there for yourselves."*
>
> *Thomas Gresham, Louisiana Department of Wildlife and Fisheries*

"If you have anything going on that is of interest to people, it just makes sense from our perspective to be the originators of the information," says Thomas Gresham, assistant director of the Louisiana Department of Wildlife and Fisheries' Public Information Office. "If you have to wait for some form of traditional media to report on a program or event that you are doing, you lose control of the story. The best thing to do is put the story out there for yourselves."

In July, the Department of Wildlife and Fisheries decided to embrace the social media trend by creating official accounts on Twitter, Facebook, YouTube, Flickr, and Scribd. Now the public can watch the department's videos on YouTube, keep up to date with the latest agency news on Twitter and Facebook, look at department photos on Flickr, or read the latest regulations on Scribd—all free of charge.

"It's worked really well, so far," Gresham says. "We have over 1,400 followers on Facebook now. Each successive week has increased exponentially."

The department pulls content for the Internet sites from the 350 traditional news releases that are sent out by the agency each year. Typically, Gresham says, the most interesting news release of the week that will appeal to the widest audience is selected for social media "posting" on Facebook and Twitter.

Video news releases that are created for television stations are now put on YouTube. "Without any additional expense to the department, we could reach literally billions of people," he says. It's also easy for staff members to upload photos to both Flickr and Facebook, and all the department's publications are shared on Scribd.

One of the ways the department is tracking its success with social media is by using Google Analytics, which provides insights into website traffic and marketing effectiveness. Gresham says the staff was surprised to see high traffic for information on snakes of Louisiana. As a result, they added new photos.

Photos and information on snakes are popular posts on the agency's Facebook page.

"Almost immediately, we started getting responses on our [Facebook] wall, and it was clear people learned a lot about snakes," Gresham says. "We're not only putting out information, but receiving information back from our constituents."

He adds, "We were maybe hesitant to implement social media, but now that we have, I think we made the right decision." ❖

The official website addresses for each of the Louisiana Department of Wildlife and Fisheries' social media links are www.facebook.com/pages/Baton-Rouge-LA/Louisiana-Department-of-Wildlife-and-Fisheries/112762357891, http://twitter.com/ldwf, www.youtube.com/user/LAWildlifeFish, www.flickr.com/photos/ldwf/, and www.scribd.com/ldwf. For more information, contact Thomas Gresham at (225) 765-2496, or tgresham@wlf.louisiana.gov.

Image courtesy of Louisiana Department of Wildlife and Fisheries

Continued from Page 7

Bay estuarine environment," McCrea says.

A five-member jury for the competition included a professor of architecture and urban design from New York, a professor of landscape architecture from Berkeley, California, a geomorphologist and researcher on how coastal marshes keep pace with sea-level rise from New Orleans, Louisiana, and a coastal engineer and a journalist from Holland.

The Winners

While the rules called for a $15,000 grand prize, with another $10,000 awarded as the jury saw fit, after a day of deliberations the jury instead divided the money equally among six winners.

"The six winning entries really begin to tell the story of adaptation to sea level rise," says McCrea.

Even though the entries were anonymous, it turned out that five of the six winners were from the San Francisco Bay area.

An exhibition of all 130 of the Rising Tides competition entries was put on public display in San Francisco. The winners can be viewed on-line at *www.risingtidescompetition.com*.

"We are thrilled," McCrea says, "not only at the way the competition turned out, but at the enthusiasm and excitement it's generated within the planning world, the coastal management world, and the design world."

He adds, "We have found that there are a great deal of ideas behind the ideas. We look forward to exploring deeper into the design concepts and sharing what we find." ❖

For more information on the Rising Tides competition, or to see the winning entries, go to www.risingtidescompetition.com. You may also contact Brad McCrea at (415) 352-3615, or bradm@bcdc.ca.gov.

COASTAL FLOODING

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MARINE SPATIAL PLANNING

Before they come to you with the next big idea.

The website is for those who manage ocean resources, providing basic information plus the tools, data, and examples needed to make marine spatial planning a reality for your locale.

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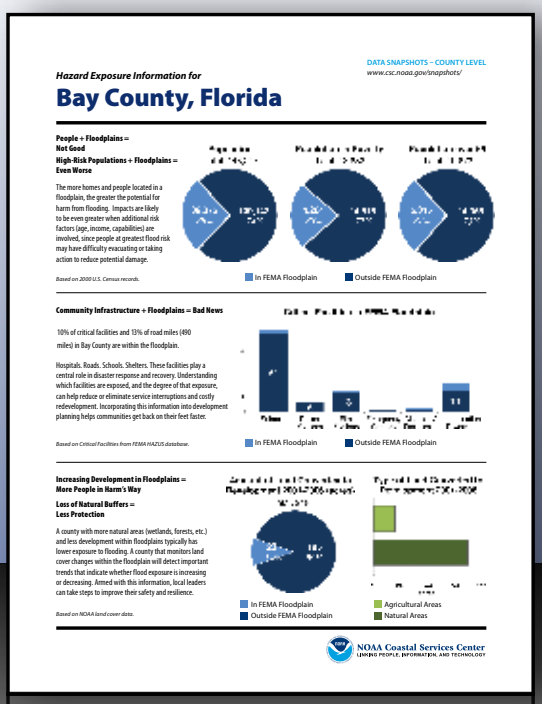

County Snapshots

Hazard Data for Gulf Coast Counties Served Up in Graphs and Charts.

MORE COASTAL COUNTIES
COMING SOON.

County Snapshots
www.csc.noaa.gov/snapshots/